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OCTOPUS MAGNIFICUS (CEPHALOPODA: OCTOPODIDAE), A NEW SPECIES OF LARGE OCTOPOD FROM THE SOUTHEASTERN ATLANTIC

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ABSTRACT

A new species of octopod, *Octopus magnificus*, is described based on a total of 131 specimens from the southeastern Atlantic. The species has been collected from 26°03′S, 13°43′E to 34°29′S, 25°36′E between 2–560 m of depth, mainly on fine sandy bottom. The species is characterized by its large overall size, long ligula, the anatomy of the male reproductive tract, the shape of the funnel organ, skin loose and elongate folds present in live animals. *O. magnificus* is compared to three large octopuses, namely *O. dofleini*, *O. maorum* and *Enteroctopus megalocyathus*.

Large octopod specimens collected for the South African Museum since 1971 were first considered to be atributable to the giant octopus of the North Pacific, *Octopus dofleini* Wülker, 1910. However, satisfactory assessment of the relationships between the South African and North Pacific forms was hampered by the poor state of knowledge regarding the systematics of the latter. The only review, by Pickford (1964), was based largely on immature animals. Recently, 14 specimens of this large octopod were caught in the southeast Atlantic off Namibia from January to July 1988. Upon examination, the specimens were considered to be distinct from all previously described taxa and to represent a new species in the genus *Octopus*. The new species is described based on 14 type specimens and 117 additional specimens. Information also is provided on the biology and ecology of the species in southeastern Atlantic. Records of *O. dofleini* from Crozet Islands, Prince Edward Island and Marion Island (Lu and Mangold, 1978; Roeleveld, 1986) are attributed with some reservation to the new species. Definitions of measurements and indices after Robson (1929), Pickford (1964), Roper and Voss (1983) and Toll (1988). The relationship between ML and TW was calculated as follows: $TW = a \cdot ML^b$.

Abbreviations.—ICM—Instituto de Ciencias del Mar, Barcelona, Spain. R. S. AFRICANA—Research Vessel Africana. SAM—South African Museum, Cape Town, South Africa. USNM—United States National Museum, Washington, D.C., U.S.A.

Octopus magnificus new species
Figures 1–8, Tables 1–5

Octopus dofleini (*non* Wülker, 1910) Augustyn and Smale, 1989:97–104.
?*Octopus dofleini* (*non* Wülker, 1910) Lu and Mangold, 1978:567–573; Roeleveld, 1986:4.

Material Examined.—TYPE MATERIAL. Holotype and paratypes measured fresh (Tables 1, 2; Fig. 1), two males (ICM91 and ICM92) and one female (ICM90) from Namibian waters, collected by Freezer Trawler SUEVE, January–March 1988, plus five males (ICM95, ICM94, USNM817139, SAM-S2363, ICM96) and six females (SAM-S2364, ICM99, ICM102, ICM101, USNM817140, SAM-S2365) from the same area, collected by the Freezer Trawler CHICHA-TOUZA, July 1988. The specimens were frozen at −20°C immediately after capture. They were measured, weighed, dissected, and photographed in the laboratory after thawing and then fixed in 10% formalin and preserved in 80% ethyl alcohol.

ADDITIONAL MATERIAL. SPECIMENS MEASURED FRESH. Forty one males and 57 females (Tables 1, 2). The following data were collected: ML, TL, and in males, length of hectocotylized arm, ligula, calamus, penis, penis-diverticulum and spermatophore, as well as hectocotylized arm sucker count.

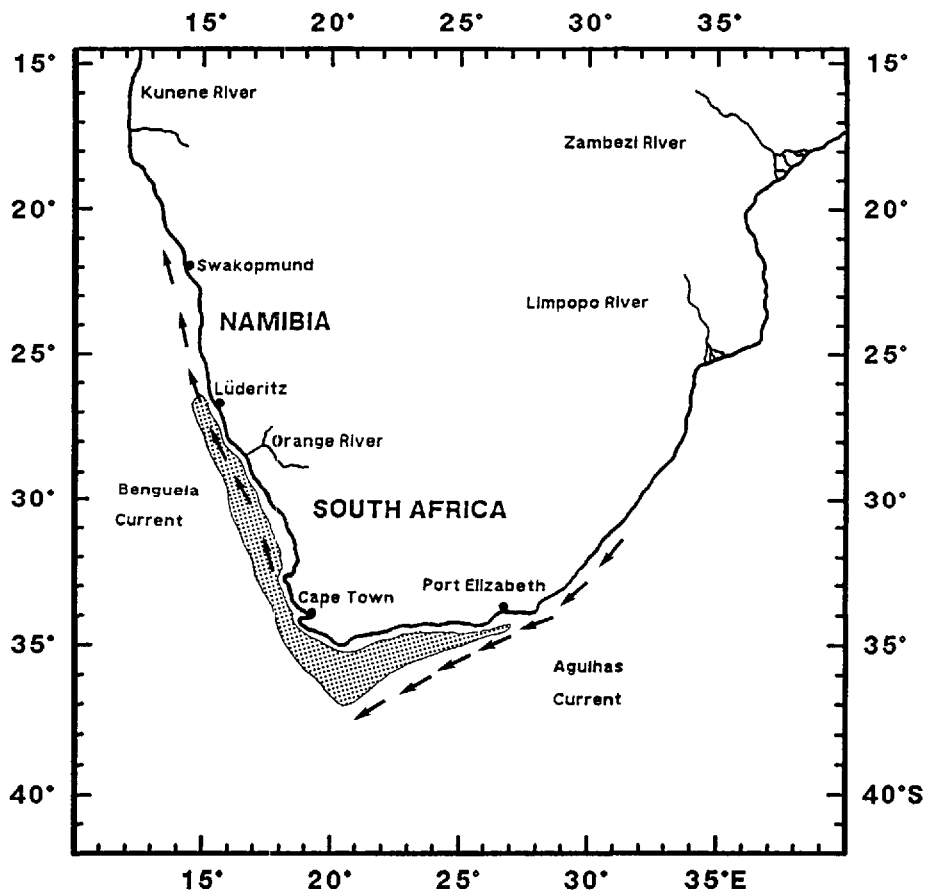

Figure 1. *O. magnificus*, new species. Geographical distribution.

Total weight and gonad weight were obtained. After having been examined, the specimens were discarded. Beaks were extracted from 93 specimens and preserved in 70% ethanol.

SPECIMENS MEASURED AFTER PRESERVATION. Nine males and 10 females (Tables 1, 5).

ADDITIONAL DISTRIBUTION RECORDS. One male 305 mm ML and 12.6 Kg TW, 2 males, 2 juveniles, 3 unsexed specimens, 30°03'S to 36°26'S, 15°21'E to 21°33'E, 80-296 m depth, November 1980 to September 1987, crayfish trap and bottom trawl; 6 males, 2 females, 29°12'S to 34°07'S, 14°45'E to 17°36'E, 224–406 m depth, 6–22 February 1988, bottom trawl, R. S. AFRICANA Cruise 059; 3 females, 33°27'S to 34°31'S, 17°32'E to 18°22'E, 240-427 m, bottom trawl, 8–12 March 1988, R. S. AFRICANA Cruise 060; 7 males, 1 female, 6 unsexed specimens, 352–6,675 g TW, 34°56'S to 35°42'S, 21°40'E to 25°36'E; 86–450 m depth, bottom trawl, 17-29 May 1988, R. S. AFRICANA Cruise 063; 2 juveniles, 30°06'S to 30°14'S, 15°54'E to 16°25'E, 182–207 m, bottom trawl, 21–25 January 1990, R. S. AFRICANA Cruise 079.

SUBANTARCTIC DISTRIBUTION RECORDS. Two females, 155 and 190 mm ML, Transvaal Cove, Marion Island, 15 m depth, gill net and fish trap, 19 April and 25 August 1985; 1 female, Marion Island, 46°40.53'S, 37°50.98'E, 460–488 m depth, dredge, 24 August 1987.

COMPARATIVE MATERIAL. *Octopus dofleini dofleini*, 1 male 242 mm ML and 1 female of 189 mm ML, Wakkanai, Hokkaido, Japan, January–March 1978. *Octopus dofleini martini*, 1 male 265 mm ML and 1 female 198 mm ML, Howe Sound, British Columbia, Canada, December 1989.

Diagnosis.—Animals large, not exceeding 362 mm ML and 12.6 kg total weight, fully mature female unknown; length of hectocotylized arm 81–95% of opposite

Table 1. *Octopus magnificus*, new species. Material examined: m.a.p.: measured after preservation; m.f.: measured fresh; dash = data missing or not available

Locality	Depth (m)	Date	Vessel	Gear	Specimens	Remarks	Cat. no.
33°41′S, 17°38′E	238	Feburary 1971	R.S. AFRICANA II	Bottom trawl	1m	m.a.p.	SAM-A31418
Bird Island, Algoa Bay	404–440	January 1972	M.V. LOBELIA	Otter trawl	3m, 4f	m.a.p.	SAM-S4
Port Elizabeth Region	440	March 1972	M.V. LOBELIA	Otter trawl	1f	m.a.p.	SAM-S6
33°45′S, 17°28′E	430	November 1972	R.S. AFRICANA II	Bottom trawl	1f	m.a.p.	SAM-S2345
Oudekraal, Cape Peninsula	2	July 1974		Scuba equipment	1m, 1f	m.a.p.	SAM-S2346, SAM-S2347.
Port Elizabeth Region	92–128	December 1975	—	—	1m, 1f	m.a.p.	SAM-S2348
Port Elizabeth Region	—	June 1976	M.V. ASTARTE	—	2f, 1m	m.a.p.	SAM-S2349
34°57′S, 21°38′E	98	December 1985	R.S. BENGUELA	Otter trawl	1m	m.a.p.	SAM-S1859
Off South Africa	—	—	R.S. AFRICANA II	Trawl	1m	m.a.p.	—
28°52′S, 14°38′E	460	January 1988	B/C SUEVE	Bottom trawl	1m	Paratype, m.f.	ICM92
27°28′S, 14°31′E	364	February 1988	B/C SUEVE	Bottom trawl	1m	Paratype, m.f.	ICM95
27°32′S, 14°31′E	402	March 1988	B/C SUEVE	Bottom trawl	1f	Paratype, m.f.	ICM90
27°00′S, 14°33′E	390	July 1988	B/C CHICHA-TOUZA	Bottom trawl	1f	Paratype, m.f.	USNM817140
29°22′S, 15°11′E	157	July 1988	B/C CHICHA-TOUZA	Bottom trawl	1f	Paratype, m.f.	ICM102
29°41′S, 14°41′E	415	July 1988	B/C CHICHA-TOUZA	Bottom trawl	1m	Holotype, m.f.	SAM-S2363
29°10′S, 14°30′E	335	July 1988	B/C CHICHA-TOUZA	Bottom trawl	1m	Paratype, m.f.	ICM96
28°22′S, 14°28′E	380	July 1988	B/C CHICHA-TOUZA	Bottom trawl	1m, 2f	Paratypes, m.f.	ICM94, ICM99, SAM-S2365.
27°29′S, 14°25′E	417	July 1988	B/C CHICHA-TOUZA	Bottom trawl	2m, 2f	Paratypes, m.f.	USNM817139, ICM91, ICM101, SAM-S2364.
From 26°03′S, 13°43′E to 28°12′S, 14°31′E	339–452	March 1989	B/C HERMANOS TOUZA	Bottom trawl	5m, 4h	m.f.	—
From 27°33′S, 14°31′E to 28°13′S, 14°48′E	387–560	April 1989	B/C ITXAS-LUR	Bottom trawl	17m, 34f	m.f.	—
From 26°37′S, 14°02′E to 29°50′S, 14°48′E	262–454	July–September 1989	B/C JANZA	Bottom trawl	16m, 17f	m.f.	—
From 29°32′S, 14°42′E to 31°17′S, 16°33′E	152–470	January 1990	R.S. AFRICANA	Bottom trawl	3m, 2f	m.f.	—

Table 2. *Octopus magnificus*, new species. Measurements and indices of 14 type specimens and 98 additional specimens (All specimens measured fresh)

Cat. No.	Paratype ICM92	Paratype ICM91	Paratype ICM95	Paratype ICM94	Paratype USNM817139	Holotype SAM-S2363	Paratype ICM96	Males			
Sex	M	M	M	M	M	M	M	N	Min	Mean	Max
ML	150	182	240	251	253	275	285	48	122	246.5	362
TL	683	751	982	1,096	1,186	1,228	1,455	39	592	1,163.9	1,673
TW	697	1,295	3,678	4,320	3,970	4,650	6,900	43	480	4,848.7	11,400
MWI	59.3	64.3	76.2	68.9	71.5	78.2	71.9	7	59.3	70	78.2
HWI	32	31.3	33.3	30.7	28.1	33	29.8	7	28.1	31.2	33.3
PAI	54.6	50	50.4	53.8	51.8	54.5	49.8	7	49.8	52.1	54.6
FuLI	26	34.6	26.6	32.6	37.9	29.8	32.3	7	26	31.4	37.9
FFuI	12	29.9	11.2	16.3	25.5	23.6	26.3	7	11.2	20.7	29.9
MAI	27.5	32.6	29.3	32.8	27.9	29.7	27.6	7	27.5	29.6	32.8
ALI	79.8	74.3	83.5	69.8	76.3	75.4	70.8	7	69.8	75.7	83.5
AWI	11.1	11.7	13.3	13	13.4	12.7	10.8	7	10.8	12.3	13.4
AAL	462.3	508.7	746.4	762	822.5	850.3	950.7	7	462.3	729	950.7
HAL	325	395	485	572	652	630	792	40	275	642.7	1,055
Arm formula	1.2.3.4	2.1.3.4	1.2.3.4	—	2.1.3.4	1.2.3.4	1.2.3.4				
AASC	237	206	261.1	247	245.7	273.2	287	7	206	251	287
HASC	97	103	99	99	107	110	102	41	92	102.7	116
SI	12.6	10	9.6	10.2	9.6	8.9	12.7	17	8.9	11.7	14.9
WDI	16.5	25.1	18.3	25.5	23.4	25.4	21.5	7	16.5	22.2	25.5
Web formula	CBDAE	BCDAE	BCDAE	CDABE	BCDAE	CBDAE	CDBAE				
HAI	216.7	217	202.1	227.9	257.7	229.1	277.9	40	189.7	263.1	544.3
OAI	69.9	77.9	67.4	70.1	78.1	75.7	—	33	66	77.9	94.6
LLI	6.5	8.1	13.4	12.1	10.3	9.9	19.4	39	3.9	13.2	22.2
CalLI	9.5	11.6	7.7	12.5	12.7	9	12.3	42	4.6	9.3	18.7
PLI	15.1	16.8	24	20.5	20.7	24.8	55.4	42	11.7	40.3	81.4
PdLI	82.4	69.3	65	67	66.7	72.8	85.4	41	65	80.2	91.8
SpLI	—	—	—	—	—	—	217.5	15	161.1	228.5	282.9
GFT	13	14	13	14	13	13	14	7	13	13.4	14

Table 2. Continued

Cat. No.	Paratype ICM90	Paratype SAM-S2364	Paratype ICM99	Paratype ICM102	Paratype ICM101	Paratype USNM817140	Paratype SAM-S2365	Females			
Sex	F	F	F	F	F	F	F	N	Min	Mean	Max
ML	116	205	268	270	300	320	321	64	116	243.5	330
TL	572	894	1,292	1,310	1,272	1,595	1,415	54	572	1,128.8	1,595
TW	472	2,110	5,300	4,650	6,000	11,500	6,700	56	425	4,656	11,500
MWI	62.1	67.4	83.9	83.3	72.3	71.8	70.1	7	62.1	73	83.9
HWI	35.3	29.7	29.1	34.4	29.6	26.8	29.9	7	26.8	30.7	35.3
PAI	59.5	47.3	59.3	49.2	54.6	47.5	48.6	7	47.3	52.3	59.5
FuLI	34.5	33.2	35.1	31.5	30.6	26.3	30.5	7	26.3	31.7	35.1
FFuI	24.1	20	24.6	20.7	21	17.2	22.4	7	17.2	21.4	24.6
MAI	27.2	31.7	27.6	28.1	31.9	26.4	29.7	7	26.4	28.9	31.9
ALI	74.5	72.4	75.1	73.4	73.9	75.8	76.4	7	72.4	74.5	76.4
AWI	13.5	14	15.8	14.1	13.8	14.2	13	7	13	14.1	15.8
AAL	395	705.6	882.5	874.5	883.7	1,091.7	1,002.6	7	395	833.7	1,091.7
Arm formula	1.2.4.3	1.2.4.3	2.3.1.4	2.1.4.3	1.2.3.4	1.2.4.3	1.2.3.4				
AASC	233.8	221.6	283	294.2	285.2	283.8	260	7	221.6	265.9	294.2
SI	10.5	9	8.8	8.6	8.5	9	8.2	19	6.5	9.6	13.7
WDI	21.4	19	23.5	21.3	24.4	22.7	24	7	19	22.3	24.4
Web formula	CDBAE	DCABE	CBDAE	CBADE	CBDAE	CBDAE	—				
GFT	14	13	13	13	13	14	14	7	13	13.42	14

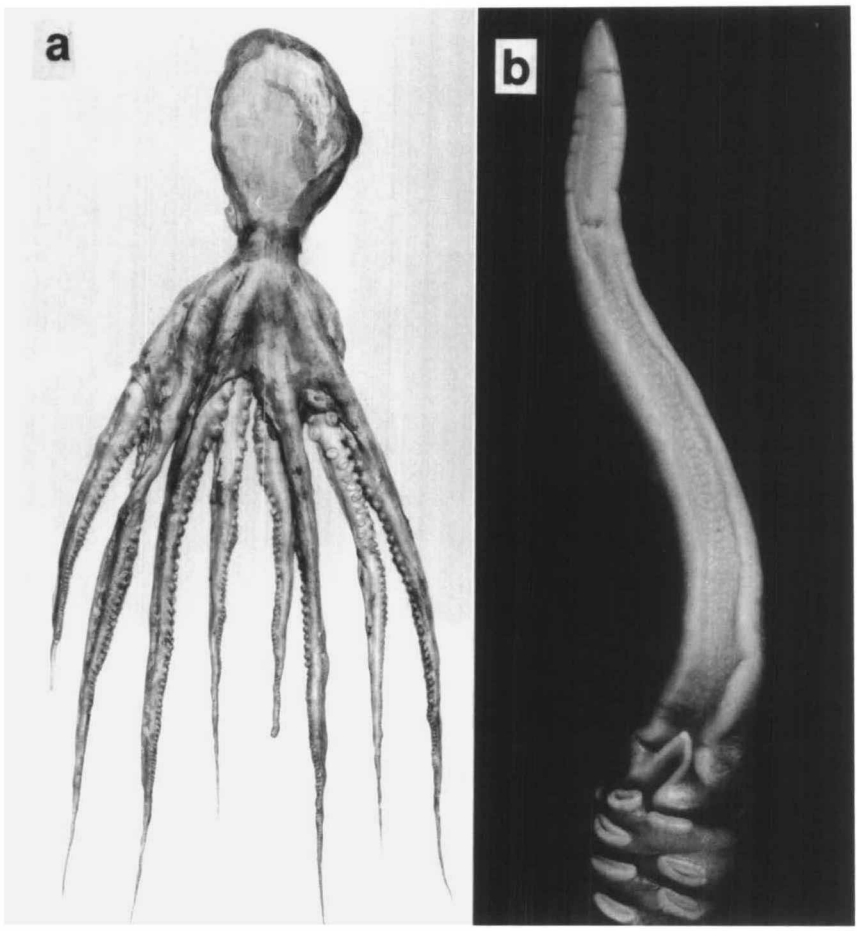

Figure 2. *O. magnificus*, new species. a. Dorsal view of the holotype, male, 275 mm ML, SAM-S2363; b. Ligula of holotype (ligula length = 62.7 mm).

arm, ligula 14–22% of hectocotylized arm in mature males; spermatophores very large, 160–283% ML; beaks without grooves on rostrum; gills with 12–15 lamellae in outer demibranch; funnel organ wide W-shape, with lateral limbs about 50% as long as medial limbs; skin loose, elongate folds present in live animals, without papillae; one large supraorbital papilla over each eye.

Description.—Octopods attaining a large size: maximum total length 1,673 mm and total weight 12.6 kg. Mantle saccular, slightly ovoid, mantle wall muscular, well developed. Mantle opening broad, reaching to posterior limit of eyes. Head narrow, set off by narrow, well defined neck and brachial crown (Fig. 2a). Eyes moderate in size, not prominent, somewhat protruding in preserved specimens. A single, large, conical, primary, supraorbital papilla (10–15 mm) located medially above each eye, more readily apparent in fresh or thawed specimens than in preserved specimens. A second small papilla occasionally present over each eye, located anterior to large papilla (Fig. 3). Funnel tubular, free for half or more its length. Funnel organ broadly W-shaped, lateral limbs considerably shorter than medial limbs. Brachial crown well developed. Arms long, with attenuated tips,

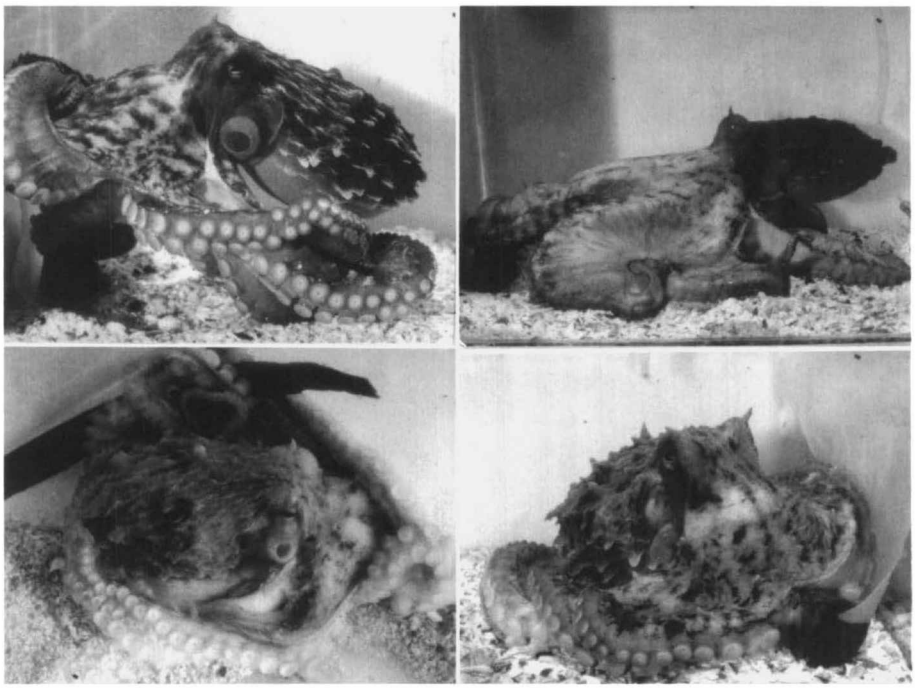

Figure 3. *O. magnificus*, new species. Female 139 mm ML, SAM-S2347, in aquarium.

muscular and robust proximally. Arm pairs I and II subequal in length, longer than arm pairs III and IV, which also are subequal. Arm formula typically I = II > III = IV, with considerable variation. Suckers biserial, proximal seven pairs of suckers small to medium, followed distally by eight larger pairs, remaining suckers decreasing in size to the tip. Specially enlarged suckers absent in males and females. Average arm sucker count 206–294 in type specimens. Average sucker count in each pair of arms, in type specimens was, 246, 243, 264, 280 in arms I–IV respectively (excluding hectocotylus). Web well developed, always shallowest in sectors A and E, remaining sectors variable, general formula not discernible. Web extending 84% along ventral side of arms I and II and 80% along arms III and IV (excluding hectocotylus). Right third arm of males hectocotylized, shorter than opposite arm (OAI = 81–95 in mature males). Hectocotylized arm sucker count ranging from 92–126 in 46 males examined (Fig. 4). Spermatophoric groove well defined, ending at base of calamus. Ligula large (LLI = 14–22.2 in mature males), inner surface of ligula sparsely pigmented, flat, not subcylindrical, with sides slightly curved inwards in the holotype (Fig. 2b). Ligula tip slightly pointed. Several rows of copulatory papillae present in medial portion of ligula; longitudinal or transverse striations absent. Calamus small (CaLI = 4.6–18.7), unpigmented, with median longitudinal groove, tip pointed and slightly erect. Gills with 12–15 lamellae in outer demibranch (usually 13–14), including terminal lamella. Digestive tract typical of genus (Fig. 5a). A pair of flattened, medium-sized anterior salivary glands attached to posterior portion of the buccal mass. Posterior salivary glands almond-shaped, yellowish after fixation, joined by salivary duct to posterior portion of buccal mass. Esophagus narrow, followed by a large, expanded, longitudinally striated crop, without crop diverticulum. Stomach

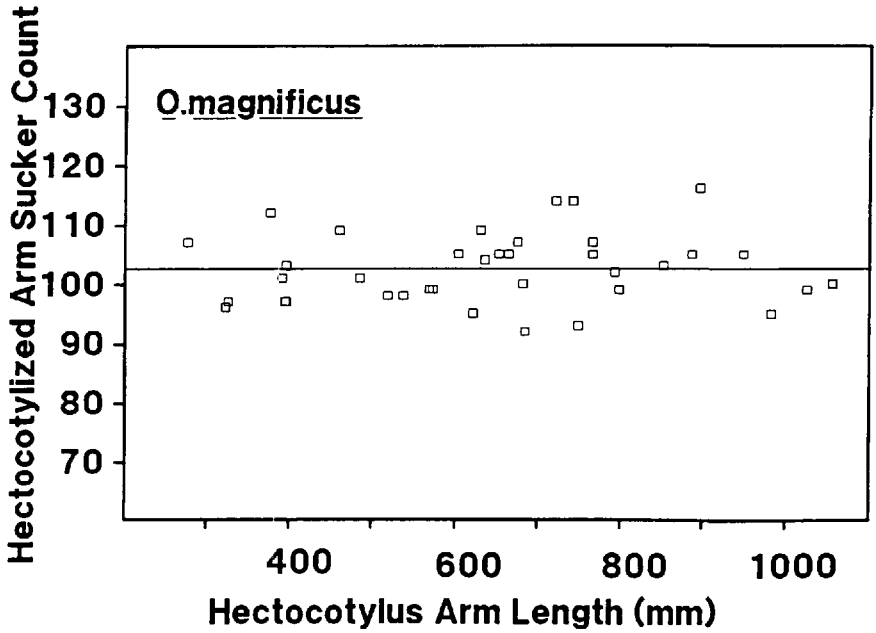

Figure 4. *O. magnificus*, new species. Scatter diagram representing Hectocotylized Arm Length against Hectocotylized Arm Sucker Count.

subspherical, muscular, with single connection to pinkish caecum and two connections to digestive gland. Ink sac embedded in digestive gland, visible at surface. Intestine long, ending in rectum at level of posterior salivary glands. Anal flaps minute. Mandibles lack distinctive features, without grooves on rostrum (Fig. 5b). Radula exhibit great individual variability (Fig. 5c, d, e). According to radula formula defined by Adam (1941), seriation of ectocones on rachidian teeth type $A_{3.2.2.2}$ in two specimens (ICM92, 150 mm ML and ICM99, 268 mm ML) and seration of type $B_{2.2.1}$ in another specimen (ICM102, 270 mm ML). First lateral tooth in specimens ICM99 and ICM102 with acute mesocone but devoid of ectocones; first lateral tooth in specimen ICM92 bears an ectocone but no mesocone. Second lateral tooth with a broad endocone and curved base. Third lateral tooth long and sabre-shaped. Marginals rectangular, plate-like. Female reproductive system (Fig. 6a) comprised an ovary and two yellowish cream colored oviducts. The oviduct is common when it leaves the ovary. Distal oviducts longer than proximal oviducts. Distal hemisphere of oviducal glands dark brown in maturing females. Maturing ovarian eggs elongate, tear-shaped, with 10–12 follicular folds, attached in ovary in yellowish white clusters by a long, thin stalk. Length of chorion chamber in ovarian eggs 6–8 mm. Ovary of maturing female (268 mm ML, ICM99) weighed 413 g and contained about 20,000 eggs. Spawned eggs unknown. Fresh gonad of maturing females 6.2–8.7% of total weight (gonad weight 450–700 g in 53 females of 5,300–10,350 g TW). Male reproductive system (Fig. 6b) with single and extremely long penis diverticulum, up to 91.8% of penis length. Fresh gonad of mature males 4.6–9.5% (mean 6.2%) of total weight (15 mature males of 4,500–11,400 g TW had gonad weights of 280–795 g). Spermatophores very long, 532–870 mm in fresh specimens (SpLI = 161–283) and few in number, always one spermatophore found in penis-diverticulum and 2–8 in Needham's sac. Oral cap of spermatophore simple, rounded. Flagellum emerges

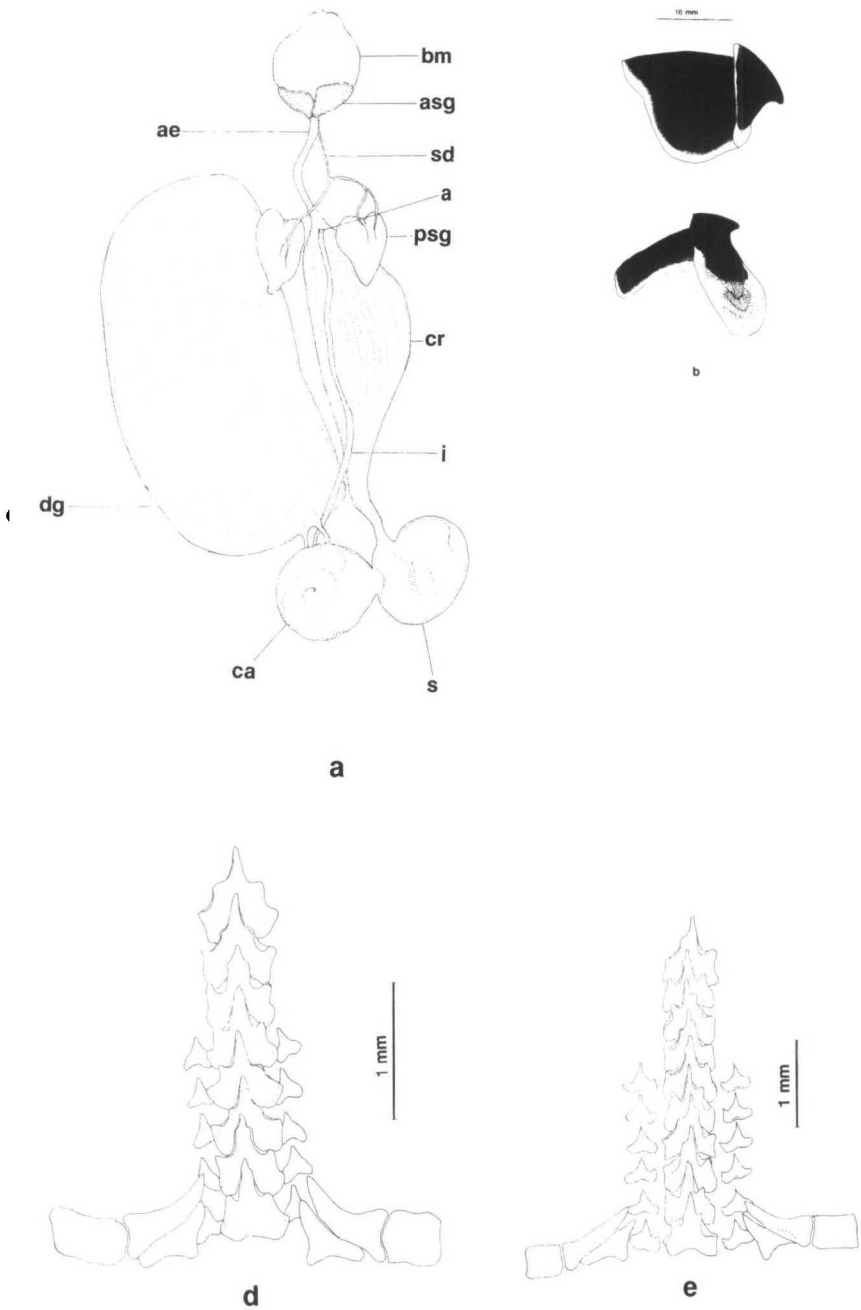

Figure 5. *O. magnificus*, new species. a. Digestive tract from male, 150 mm ML, ICM92; b. Upper and lower mandibles of male, 150 mm ML, ICM92; c. Radula of male, 150 mm ML, ICM92; d. Radula of female 268 mm ML, ICM99; e. Radula of female 270 mm ML, ICM102. (a—anus; ae—anterior esophagus; asg—anterior salivary gland; bm—buccal mass; ca—caecum; cr—crop; dg—digestive gland; i—intestine; psg—posterior salivary gland; s—stomach; sd—salivary duct).

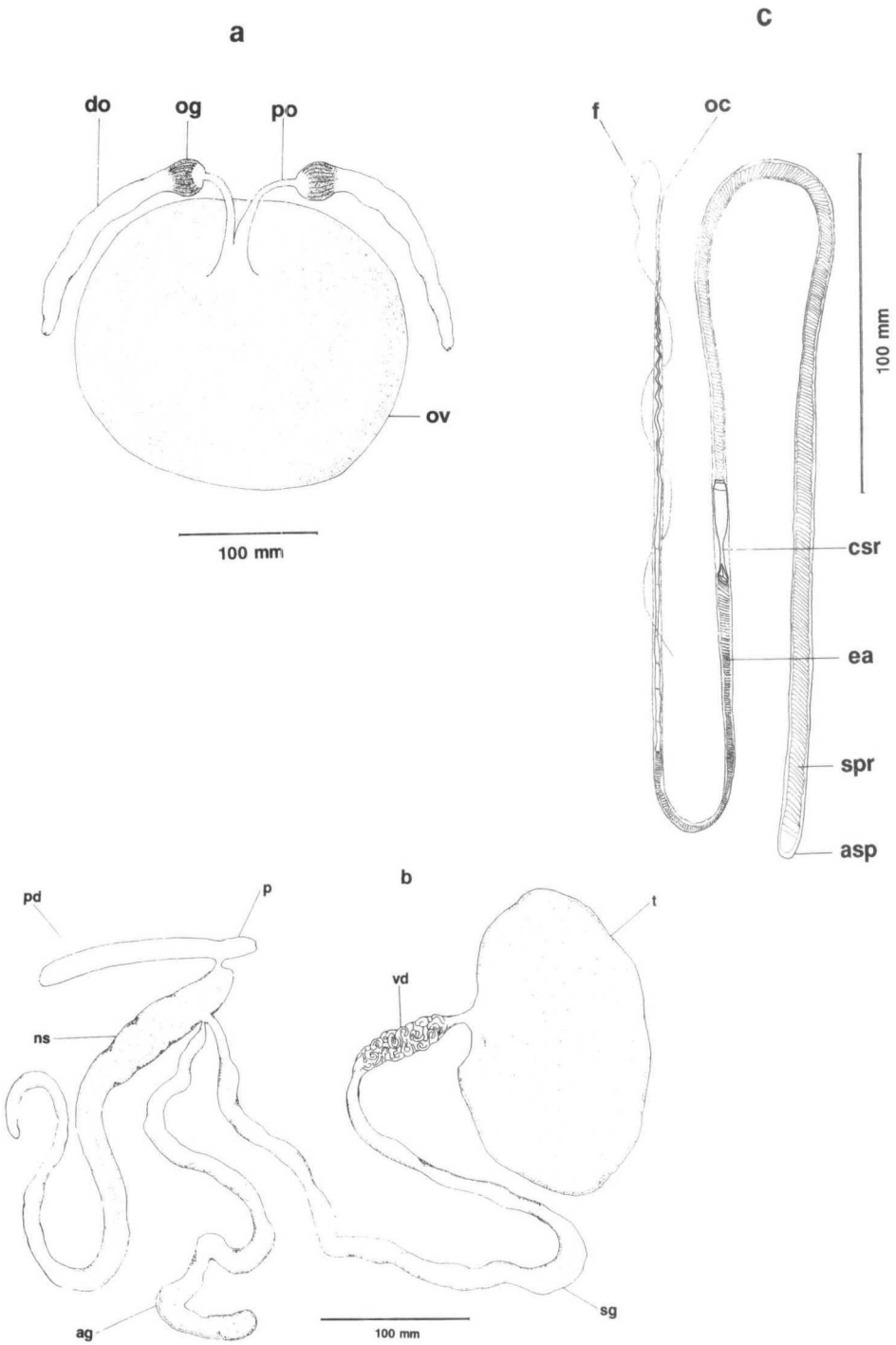

Figure 6. *O. magnificus,* new species. a. Female genitalia from female, 268 mm ML, ICM99. b. Mature male genitalia from male, 285 mm ML, ICM96. c. Spermatophore from male, 285 mm ML, ICM96. (ag—accesory gland; asp—aboral end of sperm reservoir; csr—cement body of sperm reservoir; do—distal oviduct; ea—ejaculatory apparatus; f—flagellum; ns—Needham's sac; oc—oral cap; og—oviductal gland; ov—ovary; p—penis; pd—penis-diverticulum; po—proximal oviduct; sg—spermatophoric gland; spr—sperm reservoir; t—testis; vd—vas deferens).

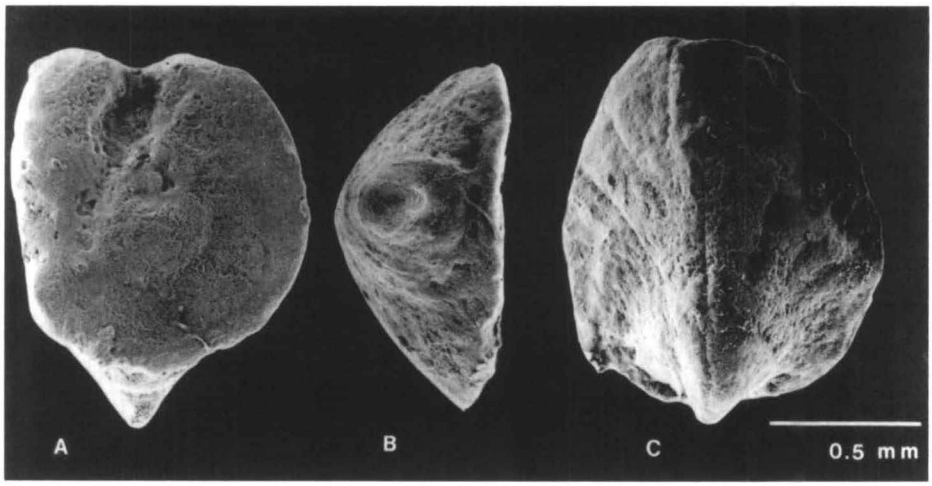

Figure 7. *O. magnificus*, new species. Statoliths. A. Female 270 mm ML, ICM102, anterior view of right statolith. B. Female, 268 mm ML, ICM99, ventral view of right statolith. C. Female 270 mm ML, ICM102, posterior view of left statolith.

from oral cap. Sperm reservoir coiled, occupying approximately half of total spermatophore length (Fig. 6c). Skin soft, smooth and loose in recently dead and frozen specimens. In life, skin erected into large longitudinal folds and small granular papillae of varying size and density. Large supraorbital papilla present, above posterior margin of each eye. Color of live animals varying from yellowish ochre to reddish brown or chocolate brown on dorsal surfaces of mantle, head and arms, paler ventrally. Edges of longitudinal folds frequently white. Recently dead animals with 25–35 faint longitudinal rows of dark yellow chromatophores on dorsal mantle surface, also extending to head. Ventral surface of mantle yellowish white. After fixation, dorsal surface of mantle and arms reddish brown, with more distinct rows of chromatophores, taking on a purplish blue or dark reddish blue. Stellate ganglia (ICM91, 240 mm ML) with 16–17 large nerves and 6–8 very thin lateral nerves radiating outwards. Optic complex dissected in two immature animals (ICM91, 240 mm ML and ICM99, 268 mm ML). Optic gland small, rounded, located at the base of olfactory lobe, yellow in color in both individuals. White body well developed, spongy, enveloping optic nerves and attached to inner surface of the eye ball. Statoliths (Fig. 7a–c) with flat, oval attachment area oval, border unserrated, and groove extending halfway into the area. Posterior surface acutely pointed, projecting beyond border of anterior surface and with narrow median furrow along entire length of posterior surface, starting at the point and ending at opposite end. Smaller diagonal grooves radiate over posterior surface from the median furrow. Shell vestige (ICM99, 268 mm ML) consist of two symmetrical rods, located above gills, V-shaped with widely separated limbs.

Holotype.—Maturing male, 275 mm ML, preserved in 80% ethyl alcohol, South African Museum, SAM-S2363.

Type locality.—Southeastern Atlantic, off Namibia, 29°41'S, 14°41'E, in 415 m.

Etymology.—The specific name *magnificus* refers to its large size and impressive appearance.

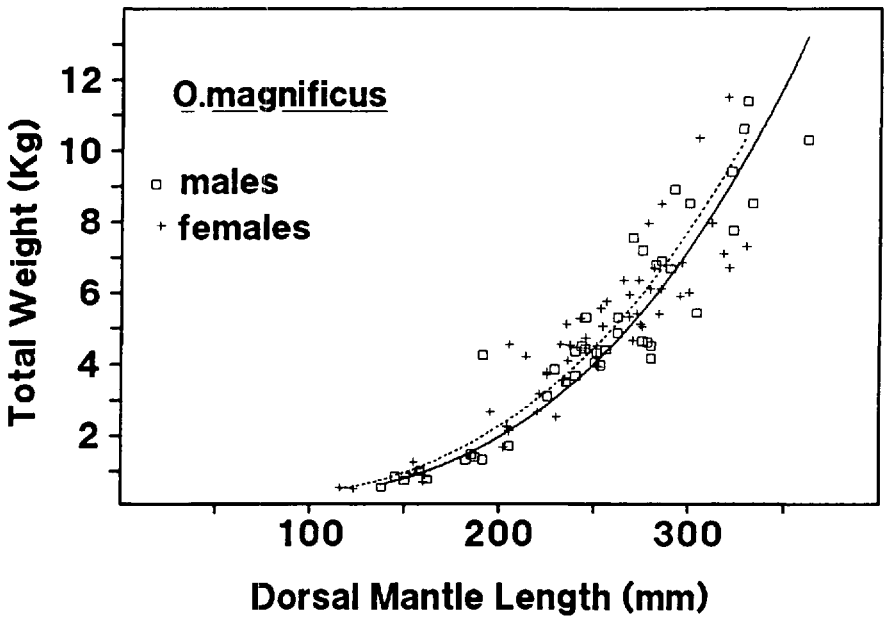

Figure 8. *O. magnificus*, new species. Relationship between Dorsal Mantle Length and Total Weight (wet).

Biological Data.—The Namibian and South African waters are characterized by the cold Benguela Current upwelling system (Shannon, 1985). *O. magnificus* has been collected at depths from 2–560 m on soft bottom sediments consisting of very fine clay and calcareous sand, in waters with 6.2–13° bottom temperatures. The south coast of South Africa is influenced both by the cold Benguela System in the west and the warm Agulhas Current from the east; in this region *O. magnificus* was collected in temperatures of 8.3°–13.5°C at 86–450 m. The occurrence of *O. magnificus* on rocky area, in Benguela and Agulhas currents has not been assessed (Fig. 1). In a total of 131 specimens examined the sex ratio approached parity, with 43.5% males. Length-weight relationships showed no significant differences between males and females (*t*-Student, $P > 0.05$) (Table 3, Fig. 8). No differences in depth distribution were found for either sex or size. Mature males were found in summer, autumn and winter, but only one immature male has been collected in spring. The smallest mature male examined weighed 4.25 kg (ML 184 mm). Mature spawning females are unknown.

Discussion

O. magnificus displays several morphological characters similar to several octopod species, *O. dofleini* Wülker, 1910, *O. maorum* Hutton, 1880 and *Enteroctopus megalocyathus* (Gould, 1852). Despite the high commercial value of *O. dofleini* (Kanamaru, 1964; Kanamaru and Yamashita, 1967; Mottet, 1975; Nesis, 1987), extensive work on its physiology (Mann et al., 1970; Martin et al., 1970; Packard and Hochberg, 1977) and ecology (Gabe, 1975; Hartwick, 1983; Hartwick et al., 1984), its systematic status is unclear. Current opinion is that it probably constitutes a group of closely related species (K. Mangold and F. G. Hochberg, pers. comm.). The most recent systematic account by Pickford (1964), concluded that the giant Pacific octopus should be treated as three separate subspecies of *O.*

Table 3. *O. magnificus*, new species. Parameters of the power curve: $TW = a \cdot DML^b$ (n, number of specimens; Vb, standard error of b coefficient)

	a	b	r^2	n	Vb
Males	0.0000762	3.22	0.92	43	0.15
Females	0.0002291	3.04	0.91	56	0.13
All specimens	0.0001479	3.11	0.91	99	0.10

dofleini in adjacent geographic regions: *O. d. dofleini* in the temperate western Pacific (Japan and Korea), *O. d. apollyon* in the subarctic northern Pacific (Siberia, Aleutians and Alaska) and *O. d. martini* in the temperate eastern Pacific (Washington to California, U.S.A.). Redescriptions of all three subspecies, based on an adequate number of specimens, are urgently required for the resolution of the systematic tangle surrounding the *O. dofleini* species complex.

Comparison with O. dofleini.—The relationship of *O. magnificus* with *O. dofleini* (Tables 4, 5) is indicated by the similar sucker counts on the hectocotylus (HASC = 98 and 109 in *O. dofleini*, HASC = 92–126 in *O. magnificus*; large ligula, LLI = 16–25 in *O. dofleini* (Pickford, 1964), LLI = 14–22, in mature *O. magnificus*; extremely large spermatophores, SpL = 600–1150 mm, SpLI = 342–346 in *O. dofleini* (Kanamaru, 1964; Mann et al., 1970; Sasaki, 1929) and SpL = 532–870 mm, SpLI = 137.5–305.6 in *O. magnificus*; and long penis diverticulum, PdLI approximately 86 in *O. dofleini* (Akimushkin, 1965) and PdLI = 65–91.8 in *O. magnificus*. However the two species also possess clearly distinct characters. *O. magnificus* differs from *O. d. martini* in the relative length of the hectocotylized arm, OAI rarely less than 90 (range 81–109, mean 94) in preserved *O. d. martini* and OAI = 76–88 in preserved *O. magnificus* (Table 5). Two small *O. d. dofleini* had opposite arm indices very similar to those of *O. magnificus* (all maturity stages), but fresh mature males had non-overlapping ranges for this character, OAI = 66.9–78.3 in *O. d. dofleini* (Sasaki, 1929) and OAI = 78.6–94.6 in *O. magnificus*. Preserved specimens of *O. d. apollyon* had OAI very similar to ranges for preserved *O. d. dofleini* and *O. magnificus*. *O. magnificus* differs from *O. d. apollyon* in sucker size. In *O. d. apollyon* the suckers are relatively larger especially in females (SI = 15.5–20.5 for males, SI = 14.4–18.5 for females) than in *O. magnificus* (SI = 9.7–22.7 for males, SI = 8.9–13.5 for females). *O. d. dofleini* is also distinct in having a funnel organ with lateral limbs almost as long as the medial limbs, whereas in *O. d. apollyon*, *O. d. martini* and *O. magnificus* the lateral limbs of the funnel organ are considerably shorter than the medial limbs. *O. d. apollyon* differs from *O. magnificus* and the other two subspecies, *O. d. dofleini* and *O. d. martini*, in having a conspicuous groove on the rostrum of both upper and lower beaks in large specimens. Transverse striations in the ligula have been reported for *O. d. dofleini* by Sasaki (1929) and Akimushkin (1965). In *O. magnificus* copulatory papillae may be present in the ligula but distinct transverse striations are not present. Skin color and texture of octopods (Packard and Hochberg, 1977; Hanlon, 1988) have not received much systematic attention but may well prove to be of systematic value once intraspecific variation has been established and character states codified. The skin type observed in *O. dofleini*, "sparsely ornamented with small papillae, (of which) four larger papillae may form a dorsal rhomb in young animals" (Pickford, 1964, p. 48), was not found in either fresh or preserved *O. mangificus*. Sasaki (1929, p. 73) also reported: "warts of various shape but usually pointed at apex and more or less stellate at base, often connected

Table 4. *Octopus dofleini martini, O. d. apollyon* and *O. d. dofleini*; measurements and indices from preserved specimens (middle numbers separated by – indicate the mean)

	O. dofleini martini				*O. dofleini apollyon*		*O. dofleini dofleini*		
			Canada†					Japan (Hokkaido)†	
Sex	Washington* 6M + 6F	California* 2M + 1F	1M	1F	Alaska* 4M + 3F	Siberia* 1M + 5F	Japan* 2M + 1F	1M	1F
ML	158–231–330	175–184–195	265	198	73–128–210	26–75–180	100–122–166	180	145
TL	945–1,222–1,620	1,050–1,169–1,230	1,225	1,012	287–609–990	62–259–585	380–500–570	935	835
MWI	67–87–102	71–78–82			60–81–89	50–79–97	79–85–97		
HWI	33–46–62	35–37–39	32.1	45.9	45–55–67	36–62–86	55–67–75	44.4	48.3
FuLI			38.1	35.8				45.5	45.5
FFuI			27.2	30				18.3	24.1
MAI			32.4	24.7			24–29–34	25.7	22.3
ALI	70–78–84	73–77–80	66.8	79.2	75–79–81	75–79–84	72–74–75	74.9	77.8
AWI			12.1	14.6				19.3	20
AAL			770.4	708				675	588.7
AASC			321.8	274.5				322	332
HASC			109					98	
SI male	12.8–15.9–18.8	9.9–13.7	10.9		15.5–17.5–20.5		15.3, 15.4	15.6	
SI female	12.4–13.2–14.2	10.5		10.6	14.4–16.4–18.5		9.4		16.2
WDI	17–24–28	18–21–24			23–27–31		23–25–26		
HAI	277.8–357.1–400	344.8, 384.6	234		232.6–303–357.1		243, 312	282.2	
OAI	88–94–109	81	83.7		75–85–96		78, 86		
LLI	14.1–19.5–23.8	9.7, 13.6	12		6.2–12.3–16		7, 12.9	13.9	
CalLI	4.8–6.7–7.6	10.3, 10.9	9.1		7.4–9.3–11.4		12.5, 17	6.1	
PLI	34–63.8–105	19, 40			20–30–39		28	33.6	
PdLI	63–76.7–85	74, 79			60–74–83			65.5	
SpLI	342, 346								
FoI	42–55–64	61	65.95				85	90.3	80.6

* source: Pickford (1964).
† source: comparative material examined.

Table 5. *Ocotopus magnificus*, n. sp., *O. maorum* and *Enteroctopus megalocyathus*; measurements and indices from preserved specimens (middle numbers separated by – indicate the mean)

	O. magnificus		*O. maorum**		*E. megalocyathus*†	
Sex	9M	10F	14M	13F	6M	6F
ML	64–183.3–245	139–189.5–230	43.5–104.5–188	11.9–79–255.3	93–112.8–128	79–114.8–137
TL	794–1,085.6–1,220	685–991.1–1,370				
MWI	55.3–71.5–99.5	61.2–75–90.1	57.7–68.3–81.6	57.1–68.6–96.2	79–85.9–89.6	62–75.5–85.2
HWI	22.9–71.5–99.5	26.5–37.7–45.3	31.8–51.5–73.2	17.6–25.7–45.7	42.9–49.9–56.3	32.8–41–46.5
FuLI	30.4–35.3–44.7	28.4–37–44.6	33.2–45–57.2	32.8–43–52.2		
FFuI	9.4–17.5–22.8	11.35–17.5–23.7	16.2–27.3–34.5	13.1–24.1–32.4		
MAI	20.5–23.5–27.1	19.3–24.8–30.4	18.7–22.4–28.5	17.6–25.7–45.7	22–24.7–27.9	20.1–23.4–26
ALI	74.3–80.1–90.2	75–78.6–83.8			74.3–76.1–77.6	74.8–76.9–78.8
AWI			5.8–9.1–12.6	7.2–9.5–12.6	20.3–22.1–24.2	12.6–18.4–24
AAL	241.8–738.2–934.7	468.3–701.5–995.2				
AASC	232.5–274.5–307.3					
HASC	106–115–126					
SI male	9.7–13.7–22.7		12.8–15.9–19.7		15–18.1–20.1	
SI female		8.9–11.4–13.5		7.4–14.7–22.1		10–13.3–15.5
WDI	17–20.5–22.7	18.6–22.6–27.1	13.8–18.9–24.1	16.7–19.2–23.2	18.1–20.9–23.4	18.3–20.1–21.7
HAI	257.1–298.1–333.7		199.6–270.8–317.3		269.9–295–322.4	
OAI	75.5–80.9–87.5		56.8–70.5–85.2		71.8–77.6–90.1	
LLI	4.2–11.2–16.3		3.4–4.7–6.5		11.1–14.9–22.4	
CalLI	9.4–10–10.2		19.8–25.7–35.1		9–11.4–14.6	
PLI	18.2–48.5–104		7.6–14.1–21.4		27.9–53.2–99.1	
PdLI	58.1–74.4–88.7					
SpLI	137.5–221.5–305.6		34.8–68.5–101.3		297.5	
FoI	74.6	60.6–62.5–64.5				
GFT	12–13.4–15	12–13.1–14	13–15	13–15	11–12.2–13	

* source: Stranks (1988).
† source: Re (1980).

together into longitudinal lines" and "some larger tubercles in addition to these warts (. . .) clearly perceptible in regular order on the dorsal surface. . . ." These characters were also present in our comparative specimens of *O. d. dofleini* and *O. d. martini* but were not found in *O. magnificus.*

Comparison with other Large Octopods from the Southern Hemisphere.—*O. maorum* Hutton, 1880 is distributed in the temperate waters of southeastern Australia and also in the temperate and subantarctic waters of New Zealand. *O. maorum* attain 255 mm ML (Table 5). *O. maorum* differs from *O. magnificus* in having spermatophoral groove poorly developed, LLI = 3–6 in mature animals, penis with a single coiled diverticulum marked with three lobes (PLI = 7.6–14.1–21.4) (middle number separated by – indicate the mean), spermatophores relatively short (SpLI = 34.8–68.5–101.3), mature eggs without follicular folds, males maturing at approximately 90 mm ML and females attaining ovarian maturity at about 120 mm ML (Stranks, 1988).

Enteroctopus megalocyathus (Gould, 1852) is distributed in the southwestern Atlantic from Argentinian waters (Gulf of San Jose, 42°S) to the Straits of Magellan, Beagle Channel and Tierra de Fuego (Re, 1980). *E. megalocyathus* attain 240 mm ML (Re, 1984). Although the male genital system, ligula and calamus are similar in both species (Table 5), *E. megalocyathus* differs from *O. magnificus* in having large ovarian eggs (9–17 mm), 11–13 gill lamellae in outer demibranch, funnel free for 1/3 its length, well developed anal flaps, relatively small head (HWI = 42.9–49.9–56.3 in males, HWI = 32.8–41–46.5 in females) spermatophores ranging from 95–390 mm (SpLI = 70–221) in males attaining sexual maturity at 115 mm ML and females at 120 mm ML (Re, 1984).

Similarities within the group of large octopods (*O. dofleini, O. maorum, O. magnificus* and *Enteroctopus megalocyathus*) suggest probable generic relationships, that may distinguish them from the genus *Octopus,* but this requires serious revision (K. Mangold and F. G. Hochberg, pers. comm.).

Comparison with other Octopods from the Genus Octopus *in the southeastern Atlantic and southwestern Indian Oceans.*—Three species of the genus *Octopus* are present in the southeastern Atlantic: *O. vulgaris* Cuvier, 1797; *O. schultzei* (Hoyle, 1910), *O. burryi* Voss, 1950 and three more species occur in the waters of the southwestern Indian Ocean off southern Africa; *O. aegina* Gray, 1849, *O. fontanianus* Orbigny, 1834 and *O. horridus* Orbigny, 1826 (Robson, 1929; Adam, 1962; Voss, 1962; Roeleveld, 1974).

O. vulgaris Cuvier, 1797 is differentiated from *O. magnificus* by its small ligula (LLI = 1.2–2.1), relatively long calamus (CaLI = 47–52) and medium sized spermatophores (SpLI = 31–61) (K. M. Mangold and F. G. Hochberg, pers. comm.).

O. schultzei (Hoyle, 1910) is differentiated by arm tips with numerous filaments instead of suckers except hectocotylus and hectocotylus with bluntly rounded ligula devoid of longitudinal depression, calamus absent (Roper and Mangold, 1991).

O. burryi Voss, 1950 is differentiated by its small size, maximum 45 mm ML in African specimens (Adam, 1960a), longitudinal dark purplish brown stripe along the dorsolateral surface of each arm and LLI = 2–6.

O. horridus Orbigny, 1826 is differentiated by reddish-purple body surface ornamented with white circular patches, each with a central papilla, ligula with of a conspicuous transverse groove below the calamus and LLI = 4 (Adam, 1959).

O. fontanianus Orbigny, 1834 is differentiated by small, circular papillae and granules over the body surface, ligula with two conspicuous "cheeks" and prominent calamus (Robson, 1929).

O. aegina Gray, 1849 is differentiated by the dorsal arm pair shorter than the

rest, hectocotylus with an indistinct spermatophore groove, LLI = 5 (Adam, 1960b; 1962; Okutani et al., 1987).

Records of "Octopus dofleini" *in Subantarctic waters.*—*O. dofleini* Wülker, 1910 has been reported in sub-Antarctic waters: Prince Edward, Marion and Crozet Islands (Lu and Mangold, 1978); Transvaal Cove, Marion Island (Roeleveld, 1986). These records are attributed with some doubt to *O. magnificus*. The specimens cited by Roeleveld (1986) are all immature females and have relatively lower gill counts, the Marion Island specimens have 10–11 filaments in the outer demibranch, compared with 12–15 in the southern African specimens.

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